

Seagrass-Watch

The official magazine of the Seagrass-Watch global assessment and monitoring program

Sea turtles

Green turtle dietary shift

Does grazing increase seagrass tolerance to eutrophication?

Bermuda triangle: seagrass, green turtles & conservation

Beccarii: tiny but mighty

Illegal trade in turtles

Protecting Thailand's seagrass meadows

Tracking green turtles

Turks and Caicos Islands

Turtle rehabilitation



In this issue:

Article	page
Green turtle dietary shift, QLD.....	2
Turtle grazing, Indonesia.....	6
Illegal turtle trade, Bangladesh.....	10
<i>Halophila beccarii</i> , Singapore.....	12
Seagrass & Turtles, Bermuda.....	16
Protecting seagrass, Thailand.....	19
Tracking turtles, QLD.....	21
Seagrass surveys, Turks & Caicos Is...24	
Turtle rehabilitation, QLD.....	27
Fibropapilloma.....	30
Sea turtle facts.....	31

From the editors

Seagrass meadows are being lost globally at unprecedented rates. Yet what we know about the consequences of this loss and its relationship with charismatic megafauna such as Sea Turtles is surprisingly limited. In this issue recent research is discussed that has sought to provide further understanding to the inter-relationship of Sea Turtles with seagrass.

The loss of seagrass in the Great Barrier Reef region due to cyclones and flooding has had evident impacts upon Sea Turtles. This issue describes the efforts of many volunteers and scientists to help save these turtles and how turtles undergo dietary shifts throughout their development that may help them survive this loss.

Discussed are studies from Indonesia and the Bermuda that document how it's not just a 'bottom-up' process of seagrass providing food for turtles, but that seagrass abundance and resilience may also be driven by the 'top-down' effects of sea turtles feeding.

In this issue you can also catch up with seagrass monitoring in the Turks and Caicos Islands, understand about the illegal trade of Sea Turtles in Bangladesh, and learn about seagrass conservation efforts on the west coast of Thailand.

COVER:

Green turtle feeding on seagrass, Green Island, Great Barrier Reef, Australia.
Photographer Len McKenzie

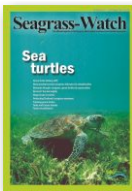
ISSN 1441-4236

Editing & additional text:

Len McKenzie, Rudi Yoshida & Richard Unsworth

Layout & graphic design:

Rudi Yoshida & Len McKenzie



Recommended citation: McKenzie, LJ, Yoshida, RL & Unsworth, R (Eds) (2011) Seagrass-Watch News. Issue 44, November 2011. Seagrass-Watch HQ. 32pp.

DISCLAIMER: while all efforts have been made to verify facts, Fisheries Queensland (a service of the Department of Employment, Economic Development and Innovation) takes no responsibility for the accuracy of information supplied in Seagrass-Watch News. The views expressed in this magazine are those of the authors and not necessarily those of the Queensland Government.

Seagrass-Watch acknowledges the Traditional Owners on whose sea country we monitor

Seagrass-Watch HQ,
Northern Fisheries Centre
PO Box 5396, Cairns. Qld. 4870 AUSTRALIA
email: hq@seagrasswatch.org

This magazine can be downloaded as a pdf from
www.seagrasswatch.org/magazine.html



As reported in the last issue of Seagrass-Watch News, flooding along the Queensland coast has had a widespread and devastating impact on the abundance and distribution of seagrasses. Heavy rainfall associated with tropical cyclones Hamish, Ellie and Charlotte during 2008/09, followed by Olga and Ului in 2009/10, was followed by the wettest year on record with four cyclones (Anthony, Tasha, Yasi and Zeila) dumping a huge amount of rain within already saturated catchments.

Cyclones and the associated heavy rainfall are a natural part of the tropical climate, however, the cumulative effects of 200 years of poor land management, combined with rural and urban development have possibly contributed to increased sediment loads, nutrients and pesticides being carried out to sea by rivers and streams. These impacts have covered seagrass meadows with sediments, reduced available light for growth, and in the case of coastal areas in the path of cyclones, physically removed the seagrasses.

This loss of seagrass meadows has clearly had major follow-on effects on the food webs of many animal species living in or off the seagrasses, including seagrass specialist feeders such as green turtles,

Chelonia mydas, and dugongs, *Dugong dugon*. Since January 2011 nearly 1200 turtles and 180 dugongs have washed ashore dead, or in various states of poor health. This is a dramatic increase in strandings along the Queensland coast compared to the number of strandings in "normal" years. With an expected best case scenario of 2-3 years for seagrass recovery, the short to medium term outlook for these animals is grim, unless they are able to successfully shift from a seagrass diet to an alternative food source.

The Turtle Research Group within the Queensland Parks and Wildlife Service have partnered with researchers from the School of Veterinary and Biomedical Science at James Cook University in an endeavour to develop pilot strategies that



Australia Dietary shift in green turtles

Article by Ian Bell & Ellen Ariel
Photography Ian Bell, Ellen Ariel
& Len McKenzie

will quantify what impact the loss seagrass is having on turtle populations in Cleveland Bay and surrounding areas.

In August 2011, armed with a copy of past seagrass maps, we conducted snorkel surveys over multiple sub-tidal sites within Cleveland Bay and on the western side of Magnetic Island to map any seagrass meadows present. What we found was worrying. None of the identified seagrass sites along the Strand, Pallarenda or around Magnetic Island had evidence of seagrass. We also checked an area between West Point and Cockle Bay on the western side of Magnetic Island, a place where we had seen and caught turtles previously.

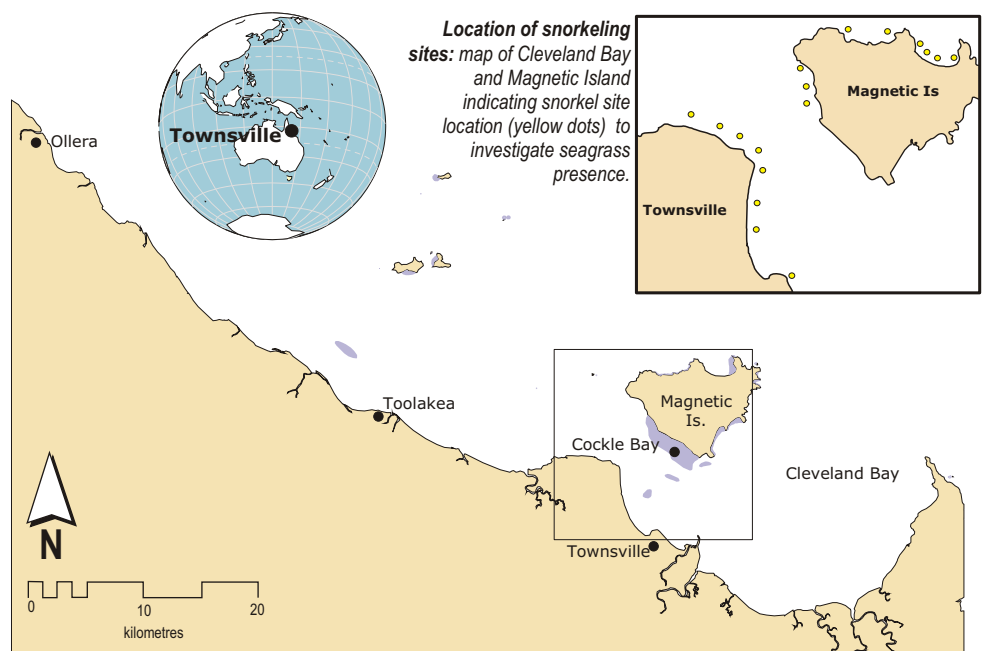
We used two methods to catch turtles for dietary examination. The first technique used specially set-up turtle-catch boats to survey intertidal areas known to support feeding turtles. Once spotted, turtles were caught by trained turtle jumpers. We also received many reports by members of the public about turtles being “stranded” in shallow rocky pools at low tide on beaches north of Townsville. We visited some of these sites and spent several days using the “beach jump” method, which involves chasing after a turtle in shallow tidal pools

and jumping on them. Once caught, turtles were either “processed” while in the boat or taken back to the shore if caught in the tidal pools.

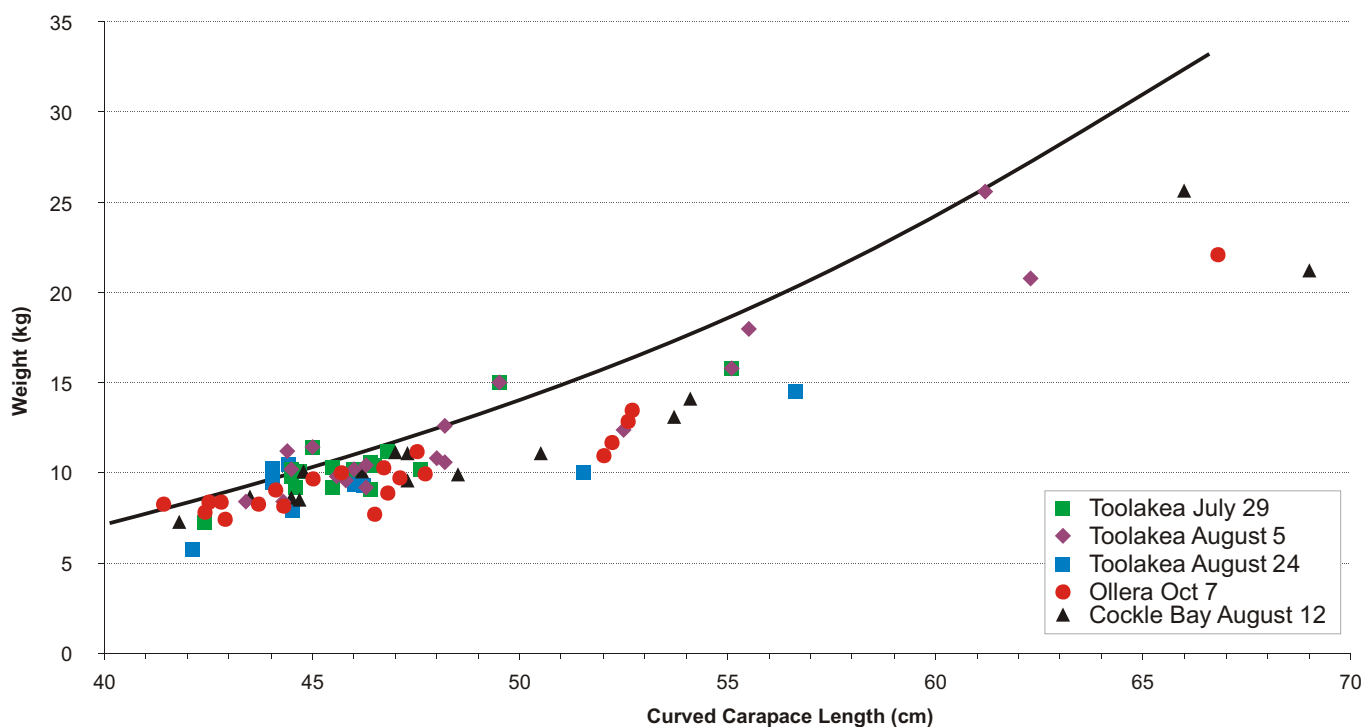
Processing involved each turtle being tagged with a titanium flipper tag, measured along the length of the carapace, weighed, checked for food items in the mouth to see what they had

just eaten, and some were stomach flushed to examine what they had been feeding on some time ago.

One of the problems we faced was trying to “quantify” a turtle in good condition compared to a turtle in poor condition. Based on approximately 150 individual historical (~20 years) records of weights and measurements, obtained from turtles



Since January 2011 nearly 1200 turtles and 180 dugongs have washed ashore dead, or in various states of poor health, which is a dramatic increase in strandings along the Queensland coast compared to the number of strandings in “normal” years.



Body Mass Index of turtles captured in Cleveland Bay and on beaches north of Townsville in 2011. Trend line indicates the weight - length ratio for a “normal weight” population of green turtles.

feeding in areas along the east coast of Queensland from Princess Charlotte Bay to the Capricorn-Bunker Group, we fitted a curve to reflect the average length to weight Body Mass Index (BMI) of a healthy population. The BMI of turtles caught as part of this project were then plotted against the fitted curve for healthy turtles to estimate their body condition.

Most turtles captured in this study were

considered to be in “poor” body condition, presenting with sunken plastrons, a lot of algal growth on their carapaces and heads and a BMI below average. While several turtles were found feeding on the seagrass *Halophila ovalis*, the majority were found to be feeding on several genera of red algae (possibly *Hypnea* and *Laurencia* sp., but we are still waiting on confirmation). The turtles

feeding on the algae were likely to have been feeding on seagrass prior to the extreme weather events of 2011.

After leaving the nesting beach as hatchlings, floating around the ocean for a few years and then recruiting into neritic habitat, green turtles are known to be able to adapt their dietary requirements according to what is available in the areas into which they recruit⁽¹⁾. If seagrass is available, they’ll eat that, if not they are quite happy to feed on algae. But being able to successfully shift from an established diet type to another may be a little more tricky. Green turtles are gut-ferment digesters, this means that, just like cows, they rely on a specific suite of gut flora to be able to break-down the ingested plant material⁽²⁾. If for example they shift from a diet of seagrass to one consisting of algae, they also need a shift in the microflora to digest the new diet and release the nutrients. .

The outcome of this study seems to contain both good and bad news. The turtles are clearly feeding on something that is an alternative to seagrass, but do they have the right suite of bacteria to be able to effectively digest the different diet?



Turtles for processing: A trailer load of juvenile green turtles hand captured in shallow rocky pools at Toolakea Beach, ready for “processing”



A rodeo-captured green turtle from Cleveland Bay: in “poor condition”, evidenced by the sternum protruding through the plastron, sunken eyes and algae growing on the head and carapace.

It also raises questions about how successfully they can swap back to a seagrass diet, if and when the seagrass recovers.

Many aspects of green turtle reproductive biology, including high fecundity and increasing survivorship through maturing age-classes, provide a buffer at a population-wide level to be able to cope with major negative impacts. A cyclone can flood nests or scour eggs from a nesting beach, or eggs can overheat and be killed during a hot and dry nesting season. However, we feel that if this mass starvation event continues for several

more years, it will not bode well for the species on a regional scale. Conservation management agencies have, and continue to try and build a resilience in marine turtle populations to be able to cope with the potential impacts that may come with climate change. This event is

likely to make that job, somewhat more challenging.

While this study is still in a developmental phase, we feel that it can provide a model that could be expanded over a far greater spatial area. Information could be used to develop and support adaptive management strategies which protect areas that are currently supporting foraging turtles, while changed environmental conditions exist.

References

1. Bjorndal KA (1980). *Marine Biology*. 56: 147-154.
2. Bjorndal KA et al. (1991). *Bull. of Marine Science*. 48:166-171.



Flushed contents (left): Processing involved each turtle being tagged with a titanium flipper tag, measured along the length of the carapace, weighed, checked for food items in the mouth to see what they had just eaten, and some were stomach flushed to examine what they had been feeding on some time ago.



A light microscope photograph (far left): (X 40) showing algal samples obtained from stomach flushed green turtles at Toolakea Beach.

Green Turtle Grazing



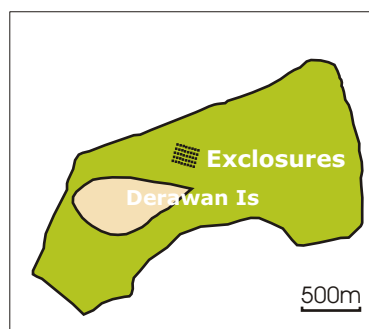
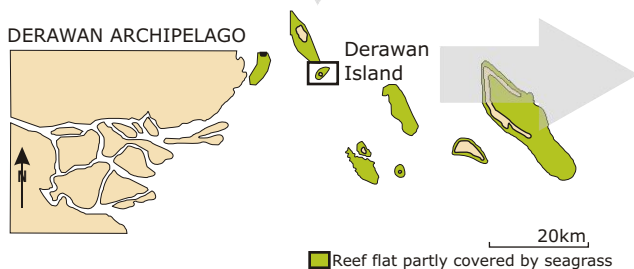
Does it increase seagrass tolerance to eutrophication?

Article & Photography Marjolijn Christianen

Before ecologists started to study seagrasses across south-east Asia, the mega herbivores of seagrasses, dugongs (*Dugong dugon*) and green turtles (*Chelonia mydas*), were already absent from most seagrass meadows as a result of overharvesting and habitat loss. But what was the role of green turtles in seagrass ecosystems? Answers can be found in the few areas where green turtles are still grazing in high densities such as Mayotte Island and Lakshadweep Archipelago, Indian Ocean where recently green turtles were found to change seagrass structure, reduce flowering and may cause species shifts. We investigated the role of green turtles in the Derawan Archipelago, Indo-Pacific, where a high density of turtles (15-19 hectare⁻¹) keep the seagrass meadows in the state of well-kept lawns.

We were particularly interested in how seagrasses could have benefited from large herbivores. Many seagrass foraging grounds are declining because they are increasingly exposed to the consequences of major changes in land use that increase riverine nutrient loads and sediment runoff, which strongly affect water quality. At the same time, most seagrass stands nowadays grow in the absence of green turtles, which were present during the past 100 million years. This raises the question whether the large-scale loss of grazing may have intensified the impact of nutrient loading. Or, in other words, can grazing increase the tolerance of seagrass systems to the now ubiquitous eutrophication?

To answer this question we built exclosures to exclude green turtles. Inside the exclosures we tested the simultaneous effects of top-down control by grazing (by artificial leaf clipping) and bottom-up control by nutrient (N & P, slow release granules) addition on seagrass and epiphyte productivity, seagrass biomass and nutrient contents.



Map of the Indo-Pacific Ocean with The Derawan Archipelago, and the location of the exclosures on Derawan Island.



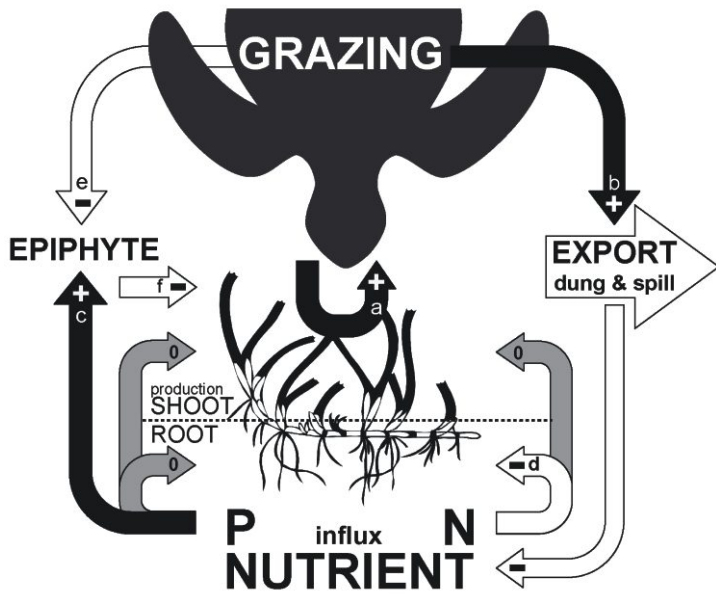
Additionally we quantified the export of seagrass biomass and nutrients by turtles outside exclosures. We tested this all in a shallow subtidal mono-species seagrass meadow characterized by *Halodule uninervis* that surrounded the pristine Derawan Island.

The results were quite striking. While the grasses proved predominantly grazing controlled and the effect of nutrient addition on seagrasses was minimal. Grazing almost doubled leaf biomass production rate, while nutrient addition did not have an effect on these rates. And nutrient addition strongly reduced rhizome biomass and thus root stabilization.

More interestingly we calculated that, in this system, turtles export 100% of the daily primary seagrass production, year-round. The turtle excrements are exported from the meadow to adjacent ecosystems passively (dung floats) or actively while they rest on the fringing coral reef between foraging shifts during low tide. In contrast to terrestrial grasslands or seagrass meadows dominated by smaller grazers, there is no recycling in these seagrass meadows. Seagrasses can't respond to nutrients because nutrients are directly exported. We assume that the excess of organic matter was exported to this reef zone (max 500 m distance) or across the reef to the open ocean's deep trenches, where seagrass detritus may support deep-sea food webs and help to sequester carbon.

By combining these quantified effects with literature data we propose a conceptual model of seagrass functioning under mega-herbivore leaf grazing and eutrophication. In tropical seagrass systems with high green turtle grazing pressure, grazing alleviates the





A conceptual model of seagrass functioning under megaherbivore leaf grazing and relatively high nutrient loads. Leaf grazing by green turtles increases seagrass production (**arrow a**) and also increases net export of the daily primary production (**arrow b**). Thus, under megaherbivore grazing, the export of nutrients from the seagrass system increases, which indirectly increases the tolerance of the system to nutrients overloading.

When extra nutrients are added, rhizome biomass decreases (**arrow d**). This may result in a destabilisation of the sediment, increasing the vulnerability to storms. Additionally, from correlative evidence in our study and from literature it is known that nutrients will increase epiphyte loads (**arrow c**), but grazing will decrease epiphyte overgrowth (**arrow e**), which will directly improve conditions for seagrass (**arrow f**).

Plus, minus and zero signs indicate positive, negative, and absent effects of one flux or turnover rate on another. Letters a - d correspond to this study, e: Short et al. 1995, f: Valentine & Duffy 2006. N = effect of increased nitrogen, P = effect of increased phosphorus. Note the positive feedback of grazing on leaf production, providing more food for turtles.

References
Short, F.T. et al (1990) Marine Ecology-Progress Series, 62:169-174.
Valentine, J. & Duffy, J.E. (2006) Seagrasses: Biology Ecology and Conservation (eds A.W.D. Larkum, R.J. Orth & C.M. Duarte), pp. 463-501. Springer, The Netherlands.

negative effects of eutrophication by the stimulation of seagrass production and concomitant nutrient uptake, the increased export of nutrients, and the indirect prevention of low below-ground biomass.

The conceptual model that we proposed shows that marine mega-herbivores do not only drive structure and functioning of their foraging grounds, but also increase the tolerance of seagrass ecosystems to eutrophication. Under increasing nutrient loads, the system's ability to absorb shocks, resist phase shifts and

regenerate after natural and human-induced disturbances, will be more and more dependent on the continuation of green turtle grazing and the subsequent nutrient export. The loss of green turtles, e.g. by illegal harvesting of eggs and adults, is therefore very likely to render the system more vulnerable to the detrimental effects of eutrophication.

Further reading:
Christianen et al. (2011). Marine megaherbivore grazing may increase seagrass tolerance to high nutrient loads. *Journal of Ecology*. (In Press).

More information:
Radboud University Nijmegen, The Netherlands, www.penyu.nl



Green turtle in front of Derawan village



illegal trade

Bangladesh

Article & Photography
Maksudur Rahman



*There are seven species of marine turtle in the world. Five species nest in Bangladesh, of which the Olive Ridley (*Lepidochelys olivacea* or *Jolpai kochhop*) and Green Turtle (*Chelonia mydas*) are found in Sundarbans aquatic ecosystems. Marine turtle species are either Vulnerable, Endangered or Critically Endangered (IUCN Red Data Book) due to illegal trade, inappropriate fishing methods (e.g., not utilizing Turtle Exclusion Devices (TEDs)), ineffective implementation of government regulations, and lack of understanding of the importance of turtles among fishermen, local people, and government officials.*

The Olive Ridley turtle is a common species in the southwest coastal part of Bangladesh. Olive Ridley turtles have various local names, such as: brojobashi, goj-kata, pankha kasim, and shagorer-kata. Every year thousands and thousands of fishermen from Chittagong, Khulna, Bagerhat and Satkhira with a Boat License Certificate from the Forest Department engage in fishing and fish-drying at dubla, alorkol and other fishing islands of the Sundarbans during winter season in the months of November-February.



Marine turtles, particularly Olive Ridley are caught in fishing nets because fishermen don't use TEDs. Sometimes, Green turtles and River terrapin (*Batagur baska*) are also caught. Fishermen are not familiar with the use of TEDs or the plight of marine turtles and their conservation need. As a result, most of the marine turtles (55 - 60%) drown in fishing nets or are sold in the coastal markets.

Images: Turtles for sale at the Rupsha Fishing market (above). Turtle, slaughtered and on sale at the Digraiz Market (close to Bay of Bengal). The Trader sold Olive Ridley meat at the market (left)

It is common to see Olive Ridley turtle meat openly for sale in the coastal areas of Bangladesh from December to March every year. Turtles averaging 12-14 kg are purchased from the fishermen of the Bay of Bengal for Tk 1000-1100 and the turtle/meat is then sold in the coastal markets for Tk 120-130/kg.

Previously when fishermen caught a marine turtle in their net, they would either kill it or release it, as marine turtles would not sell. But now-a-days there is a market for marine turtles due to a shortage of freshwater turtles.

Marine turtles are protected under the Bangladesh Wildlife Preservation Act. However, turtle traders are apparently unaware of the Government rules and regulations regarding marine turtle trading. As a signatory to the Convention on Biological Diversity, Convention on Migratory Species, and Memorandum on the Indian Ocean Sea Turtle Conservation, Bangladesh has a responsibility to take appropriate measures for the conservation and management of marine turtles.

Considering female marine turtles have travelled more than a thousand kilometres to nest on the beaches of Bangladesh, it is unfortunate they get caught in fishermen's nets. Despite laws protecting marine turtles, the illegal trade of meat, eggs and shells of turtles continues to be a threat. Enforcing legislation and educating local communities on the economic benefit of a live versus a dead marine turtle is essential to eliminating illegal trade. If the marine turtle trade continues, turtle populations will continue to decline.

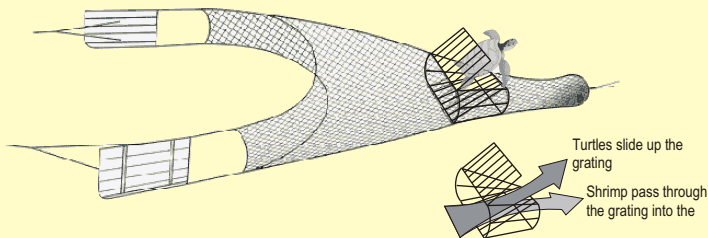


More information:
Bangladesh Environment and Development Society (BEDS), sites.google.com/site/bedsbd/

One of the major threats to marine turtles in the marine environment is incidental capture, injury, and mortality during fishing operations. A turtle excluder device or TED is a specialised device that allows a captured sea turtle to escape when caught in a fisherman's net. TEDs usually include a metal grid, much like a storm-water-drain grate (hard TEDs) or a panel of large mesh webbing (soft TEDs) integrated into the trawl net structure at an angle between 40° - 60°⁽¹⁾. The grids act as a barrier for large creatures such as turtles from passing through the bars into the back of the net. A small opening in the net is then available either above or below the grid so that the creatures that are stopped by the TEDs are allowed to escape the net, relatively unharmed. The exit hole may be partially covered by a flap of webbing to reduce the possibility of losing shrimp.

TEDs come in many designs and like other fishing gear, no single design is suitable for all fishing conditions. When working properly, catch loss associated with these devices is minimal, with indications that they may improve the quality or the quantity of the shrimp catch in certain circumstances. More recently TEDs have been refined to also reduce other forms of bycatch. The TTED (Trash and Turtle Excluder Device) reduces sorting time and risks of injury due to sharks and rays being caught⁽²⁾.

The mandatory use of TEDs in many countries is helping to prevent sea turtles from being caught in trawl fisheries. Although the Government of Bangladesh made the use of TEDs mandatory for shrimp trawlers⁽³⁾, the use of a TEDs is not popular as trawler owners argue that it would also allow large size commercial fish to escape from the net.



1. www.dpi.qld.gov.au/28_16256.htm
2. www.nmfs.noaa.gov/pr/species/turtles/teds.htm
3. Rahman (1999) www.fao.org/docrep/007/y2859e/y2859e01.htm





tiny but mighty Singapore **beccarii** 'Critically Endangered'

Article by Ria Tan, Siti Maryam Yaakub & Andy Dinesh
Photography Ria Tan (Wild Singapore)



Considered globally rare, *Halophila beccarii* is listed as “Vulnerable” worldwide. According to the IUCN, this seagrass is estimated to occupy less than 2,000 km² with a patchy and fragmented distribution in the Indo-Pacific.

Halophila beccarii has a narrow, restricted depth range. The intertidal area where they grow are subject to much human disturbance. Although it is fast-growing and may recover quickly from disturbance, global population trends indicate this species is declining.

In Singapore, this diminutive seagrass is listed as 'Critically Endangered' in the Singapore Red Data Book (2008) due to its limited distribution on Singapore's shores.

Halophila beccarii is easily overlooked. It is tiny, often occurs in small patches, and resembles scum or algae when out of water. In some specimens found in Singapore, *Halophila beccarii* have a

reddish-brown banding pattern resembling stripes on the leaves which has earned it the title "tiger seagrass" amongst some seagrass nerds here in Singapore.

Previously, *Halophila beccarii* was seen at Sungei Buloh Wetland Reserve proper (near the Mangrove Boardwalk) and at Chek Jawa, Pulau Ubin, with small patches on the northern shore, near the boardwalk's T-shaped extension, and larger patches on the southern shore besides House No. 1.

Recently, extensive *Halophila beccarii* meadows have been seen on Singapore's northern shores that face the Johor Strait. First spotted in December 2010, field trips in January - March 2011 discovered more

about the full extent of vast meadows which lie outside the Sungei Buloh Wetland Reserve proper.

At Kranji Nature Trail that lies east of Sungei Buloh Wetland Reserve, *Halophila beccarii* meadows were seen to form an almost continuous 500-metre strip along the Trail. The seagrass was growing under almost every large mangrove tree, particularly among trees with pneumatophores like *Avicennia alba* which are plentiful here. The meadows range in width from 1m to about 10m, starting from under mangrove trees, extending seaward to about where the pneumatophores end. The seagrass was also found among trees growing on sand

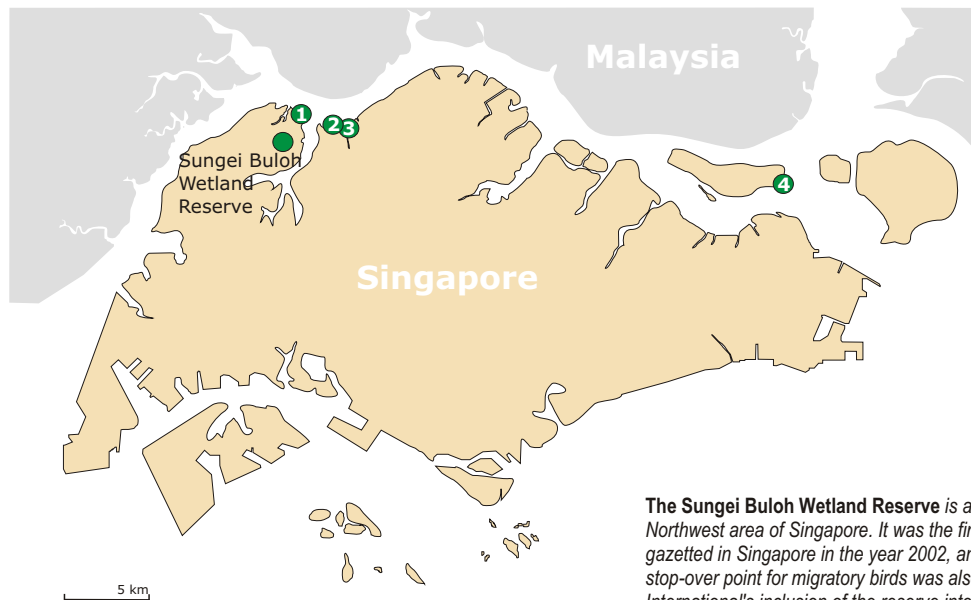
In some specimens found in Singapore, *Halophila beccarii* have a reddish-brown banding pattern resembling stripes on the leaves which has earned it the title "tiger seagrass"



1 *Halophila beccarii* at Kranji Nature Trail was found growing under almost every large mangrove tree, particularly among trees with pneumatophores like *Avicennia alba* which are plentiful here. The meadows range in width from 1m to about 10m.



2 *Halophila beccarii* meadow at Kranji (East), at the mouth of Sungei Mandai Besar with Johor Baru (Malaysia) in the background.



Key:
 1. Kranji Nature Trail
 2. Kranji East
 3. Sungei Mandai Besar
 4. Chek Jawa

The Sungei Buloh Wetland Reserve is a nature reserve located in the Northwest area of Singapore. It was the first wetlands reserve to be gazetted in Singapore in the year 2002, and its global importance as a stop-over point for migratory birds was also recognised by the Wetlands International's inclusion of the reserve into the East Asian Australasian Shorebird Site Network. The reserve, with an area of 130 hectares, was listed as an ASEAN Heritage Park in 2003.
 Source: http://en.wikipedia.org/wiki/Sungei_Buloh_Wetland_Reserve

3 *Halophila beccarii* at Mandai mangroves the meadows here stretched about 250m along the stream and varied in width from 10m to 20m.



4 *Halophila beccarii* growing near House No. 1 at Chek Jawa, Pulau Ubin, after the oil spill (see Issue 41 Seagrass-Watch News).



“This diminutive seagrass is listed as 'Critically Endangered' in the Singapore Red Data Book (2008) due to its limited distribution on Singapore's shores...”



bars in front of some parts of the shore. The only areas without the seagrasses were those heavily impacted by litter, and these areas were not large.

Lush meadows were also seen on both sides of Sungei Mandai Besar, a small mangrove stream that divides Kranji east from Mandai mangroves. On the Kranji east bank of the stream, the *Halophila beccarii* meadows covered an area of about 100 metres square. On the Mandai mangroves bank of the stream, the meadows stretched about 250m along the stream and varied in width from 10m to 20m. The *Halophila beccarii* blades here grew densely, close to one another forming a thick carpet. In some small spots, the seagrass grew so lushly that the blades 'stand up' even when out of water.

The seagrass meadows are fully exposed at low spring tide. The seagrass was seen growing on soft silty mud as well as sandier areas, both under mangrove trees and in unshaded areas. In the Mandai mangroves, the meadows even extended to the back mangroves growing along small streams that wind their way towards the sea.

Many egrets were seen resting in deeper water near these meadows at low tide.

Few patches of *Halophila beccarii* were found along the northern shore between Kranji Nature Trail and the Kranji east shore next to Sungei Mandai Besar. Although this stretch of shore also has mangroves, the trees here form a narrow band and this area is heavily affected by debris, much of which seem to have been dumped from land and did not drift in by sea.

It was interesting to observe that mangrove saplings are often seen in these *Halophila beccarii* meadows. Stands of regularly spaced *Sonneratia alba* saplings of similar height are particularly commonly seen in the meadows that grow beyond the shade of large mangrove trees.

Why were these *Halophila beccarii* meadows only recently observed? Have they been overlooked all this time? Or did the year end monsoon and particularly the heavy rains in January 2011 lead to better growth of the seagrass?

We shall have to keep a closer eye on these precious meadows to find out more about them!



References
Halophila beccarii on the IUCN Red List of Threatened Species
<http://www.iucnredlist.org/apps/redlist/details/173342/0>

***Halophila beccarii* (Mandai mangroves)**
On the Mandai mangroves stream bank, the meadows stretch about 250m along the stream, with varied width from 10m to 20m. *Halophila beccarii* grows densely here, close to one another forming a thick carpet. In some small spots, the seagrass is so lush that the blades 'stand up' even when out of water.

bermuda triangle

seagrass green turtles & conservation



Article by Jud Kenworthy,
Sarah Manuel, Jim Fourqurean,
Kathy Coates, & Mark Outerbridge
Photography Kim Holzer
& Jud Kenworthy

DESPITE IT'S ISOLATION in the open waters of the western Atlantic, the shallow Bermuda platform is a uniquely diverse and productive marine ecosystem supporting four species of tropical seagrasses growing at their northern geographical range limit in the Atlantic. Located near the Gulf Stream current and in the northwestern Sargasso Sea, the platform is bathed in warm, clear oligotrophic waters; ideal conditions for a diversity of tropical species.

Recognizing the ecological value of seagrasses, the Bermuda Department of Conservation Services embarked on a benthic habitat monitoring and research program on the platform⁽¹⁾. The urgency of this program was prompted by concern for a recently documented but unexplained decline of seagrasses in Bermuda⁽²⁾. Lead by biologists Drs. Sarah Manuel and Kathy Coates with assistance from Anson Nash, along with Dr. Jim Fourqurean (Florida International University) and Dr. Jud Kenworthy (NOAA retired), the Department's team implemented the first comprehensive platform-wide benthic habitat and water quality monitoring program in 2005. Modelled after the monitoring program in the Florida Keys National Marine Sanctuary⁽³⁾, data provided by this project are being used by the Bermuda Government to better understand the ecology of seagrasses and improve the management and conservation of Bermuda's marine resources.

The Sargasso Sea gyre is also one of the most important epi-pelagic habitats for juvenile sea turtles, including the green turtle (*Chelonia mydas*), found within the Atlantic Ocean⁽⁴⁾. Acting like an aircraft carrier, the Bermuda platform intercepts the flight of some of these young turtles as they move around the gyre during the first 5-10 years of their life, eventually landing on the platform where they reside for up to 2 decades before leaving to return to their





Experimental enclosures: Photos showing the effect of an experimental turtle enclosure on a *Thalassia testudinum* meadow at the Chub Head Reef on the Bermuda platform. Note the robust canopy of *Thalassia* underneath the enclosure and the sparse canopy outside. Outside the enclosure in the right photo you can also see small circular patches where physical and biological activities are disturbing the grazed canopy.

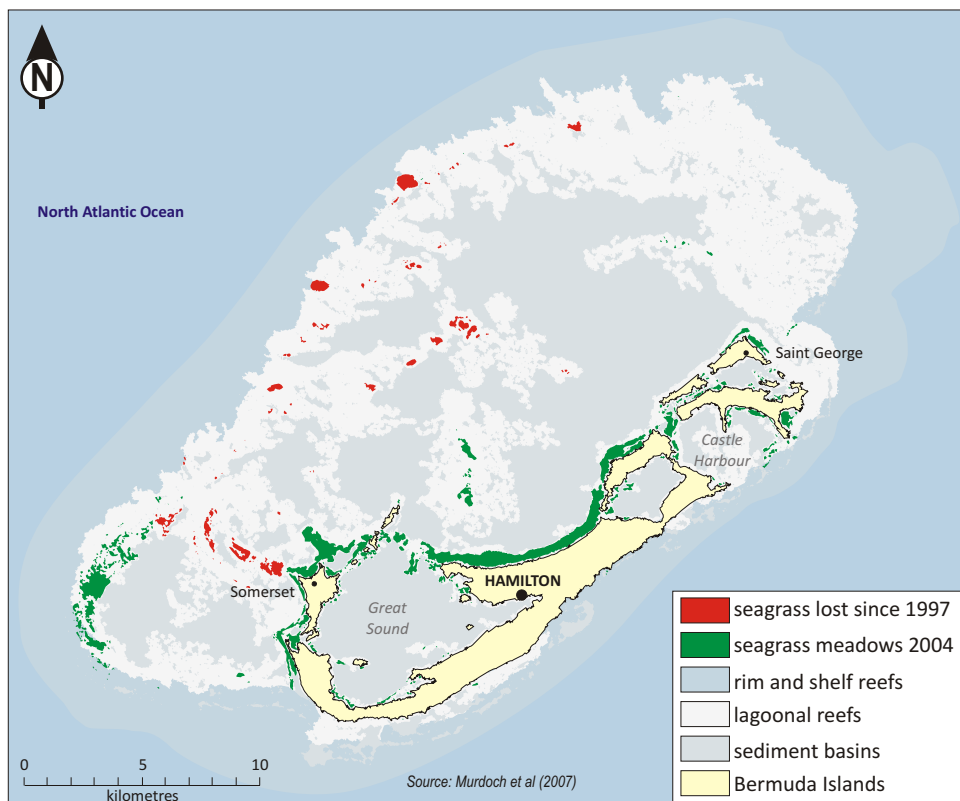
natal regions to reproduce⁽⁵⁾. With coral reefs distributed across the platform and almost always in close contact with seagrass meadows, the young turtles are never far from shelter or food. Benefiting from complete protection provided by the Bermuda government and having few predators, the green turtle population in Bermuda appears to be flourishing.

During their extended period of residency the turtles establish specific feeding areas on the platform where they intensively graze on seagrasses. Using

experimental turtle enclosures to prevent foraging, studies have shown how turtles contribute to the formation of unvegetated halos and bio-physically disturbed areas with reduced seagrass biomass around the reefs where turtles shelter⁽⁶⁾. For more than two decades the Bermuda Turtle Project has been conducting “entrapment net” capture surveys to monitor and tag juvenile green turtles across the platform⁽⁷⁾. Based on these surveys and monitoring conducted by the Bermuda Caribbean Coastal Marine Productivity

(CARICOMP) site at Crescent Reef, there is evidence that the turtles may eventually abandon heavily grazed areas and move to new locations on the platform. Seagrass recovery in heavily grazed areas is very slow, suggesting that green turtles may be contributing to local fluctuations in seagrass abundance.

The Department of Conservation Services and the Bermuda Turtle Project recognize that understanding the interactions between green turtles and seagrass ecology is vital to conserving



During their extended period of residency the turtles establish specific feeding areas on the platform where they intensively graze on seagrasses

biodiversity on the platform. During a recent collaboration with Mark Outerbridge and the Bermuda Turtle Project, staff from the two programs along with volunteers captured 12 green turtles at a nearshore station typical of the reef/seagrass meadow contact seen throughout the platform. While encircling the target area with a specially designed entrapment net, teams of snorkellers patrolled and disentangled the captured sea turtles. The turtles were then carefully transferred to a larger vessel for data collection where they were inspected for the presence of tags and their general health and condition noted. All of the animals were tagged, measured, weighed and a biopsy was taken from the rear

flippers for DNA analyses, after which each turtle was carefully released at the capture site. Data from this collaboration improves our knowledge of the biology, site fidelity, movements and population sizes of green turtles on the platform. Integrating these turtle population data with information about seagrass distribution, production and response to grazing will contribute to a better understanding of the carrying capacity of the platform and the role of green turtles in affecting the distribution and abundance of seagrasses.

“Benefiting from complete protection provided by the Bermuda government & having few predators, the green turtle population in Bermuda appears to be flourishing...”

References

1. <http://www.conservation.bm/bmmmap/>
2. Murdoch et al. (2007) *Marine Ecology Progress Series* 339: 123-130
3. http://ocean.floridamarine.org/fknms_wqpp/pages/sgmp.html
4. <http://www.cccturtle.org/bermuda/>
5. <http://www.cccturtle.org/bermuda/discoveries.htm>
6. Fourqurean et al. (2010) *Marine Ecology Progress Series*. 419: 223-232
7. Meylan et al. (2011) *Bulletin of the American Museum of Natural History* Number 357, 70pp.



Tagging the turtle: Mark Outerbridge prepares to insert a pit tag into the flipper of a captured juvenile green turtle.

The Sargasso Sea gets its name from massive amounts of floating Sargassum (brown drift algae) that can aggregate to form extensive floating mats on the surface of the ocean. Defined by the currents that envelope it, the Sargasso Sea is seasonally dynamic as well as the only “sea” without coastlines. Sitting on the North Atlantic Subtropical Gyre and correlated roughly with the Azores High Pressure System, the Sargasso Sea at any given time is approximately 1126 kilometers wide and 3219 kilometers long⁽¹⁾. A considerable wealth of information about the Sargasso Sea exists, dating back to the times of Columbus and documented in scientific publications from at least the year 1854⁽²⁾.

The Sargasso Sea provides habitats, spawning areas, migration pathways and feeding grounds to a diverse assortment of flora and fauna, including endemic, endangered, and commercially important species.

References:

1. Conover, J.T. and J.M. Sieburth. 1964. *Botanica Marina* 6: 147-157
2. Stevenson, J.J. 1910. *Science* VOL. XXXII. No. 832 841-843

Source: <http://www.gobi.org/Our%20Work/rare-2>
<http://www.sargassoalliance.org/about-the-sargasso-sea>

Recording data: Project staff and volunteers record data from captured sea turtles. All of the animals were tagged, measured, weighed and a biopsy was taken from the rear flippers for DNA analyses, after which each turtle was carefully released at the capture site. Data from this collaboration improves our knowledge of the biology, site fidelity, movements and population sizes of green turtles on the platform





Thailand

protecting seagrass meadows

Article by Barry Bendell
Photography Barry Bendell & Piyapat Nakornchai

Enhalus acoroides: in the protected area near the Tha Payoi pier

BB



TWO VILLAGES on the island of Phra Thong on Thailand's Andaman Sea coast have decided to set up small protected areas to conserve resources in their local seagrass meadows. Those meadows are an important source of fish, crabs and molluscs.

Among the most significant harvested animals have been *Strombus canarium* or dog conch (*hoi chak teen* in Thai), and the sea cucumber *Holothuria scabra* or sandfish (*pling kao* in Thai). Monitoring of the seagrass and its animals provides an important tool for supporting community initiatives to conserve and manage their own resources.

Phra Thong is a large island, 15 km long and almost 9 km at its widest point, with extensive mangroves and seagrass meadows on its eastern side. Ten species of seagrass have been identified around the island, and they occur primarily in intertidal areas. The dominant species are *Halophila ovalis* on the higher sites, and *Enhalus acoroides* in deeper water. The feeding trails of dugongs have often been encountered in dense patches of *Halophila ovalis* around the island, including the newly established protected areas.

Local people of all ages harvest the bounty of the meadows during periods of low tide. An individual can collect several kilos of shells, mostly conches, by searching on foot. They will also collect cockles, ark clams, crabs, sea cucumbers and any other edibles they may encounter. Many of the molluscs are consumed

in the villages, but conches also reach local markets and restaurants. The intense harvesting activity around villages has a huge potential impact on seagrass ecosystems, but has been largely unevaluated.





High densities of the seastar *Archaster typicus* at Lion Village

Edible sea cucumbers have become increasingly uncommon in the meadows, and many of those that are collected now are small and immature, with larger individuals coming from deeper water. They are not consumed in the villages, but are prepared for sale by boiling and drying. There is high demand for sea cucumbers as food and medicine in Chinese markets, and they have declined in numbers throughout most of Asia due to over-fishing. *Holothuria scabra* is the species most commonly associated with seagrass and is amongst the most highly valued.

In late July 2011, the villages of Tha Payoi and Lion (also known as Pak Chok) used buoys to mark out marine protected areas (MPAs) around the seagrass meadows nearest their communities. All fishing activities have been prohibited in those areas, except for the use of mullet nets at the Tha Payoi site. The protected areas are expected to increase the abundances of animals, and provide nursery habitat and shelter for a diversity of animals, including fish and crustaceans. The MPAs are both approximately 14 ha in area. At Tha Payoi, it is on a sand bar in front of the village pier, and the high visibility of the site makes it unlikely that violations of no-take regulations will go unseen.

At Lion village, seagrass has been monitored in two plots since 2009 under projects supported by two NGOs working on the island, Mangrove Action Project⁽¹⁾ and Naucrates⁽²⁾. One of those plots is now inside the newly created MPA at Lion village, and the other is just outside. A new monitoring plot has also been established in the MPA at Tha Payoi, and another in an unprotected area between the villages. Future monitoring of the seagrass will allow a comparison between plots in and outside the MPAs.

Animals are also being monitored in the same areas. Their numbers have been counted and recorded in 1m belts on either side of 50m transect lines. Initial surveys suggest that numbers of conch and sea cucumber are uniformly low in the monitoring areas. At Lion village the most abundant large invertebrate is the

sea star *Archaster typicus*, which can reach extraordinary densities greater than 1 per metre.

The villages of Tha Payoi and Lion want to conserve and manage resources for their future use. Marine protected areas have become common tools for managing coastal resources, but there are few evaluations of their effectiveness, especially of small-scale areas in seagrass meadows. By monitoring the seagrass and its animals, protected areas can be assessed and the data used to inform and support community-based initiatives in those villages and others in the region.

Monitoring at Phra Thong has been supported by the Rufford Small Grants Foundation and by the Planeterra Foundation.

- References
 1. Mangrove Action Project MAP www.mangroveactionproject.org
 2. Naucrates www.naucrates.org

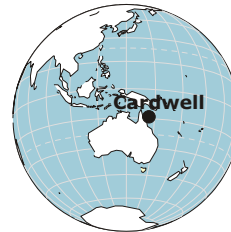


Catch: A fisherman at Tha Payoi prepares his catch of sea cucumbers.

Australia Tracking turtles

Article by
Phil Koloi

Photography
Phil Koloi & Len McKenzie



The Great Barrier Reef Marine Park Authority (GBRMPA), the Queensland Parks and Wildlife Service (QPWS), James Cook University (JCU) and Giringun Saltwater Rangers are researching green turtle behaviour changes in response to the lack of food following the declines in seagrass after the floods and cyclone Yasi in early 2011.

As a result of the degradation of the Great Barrier Reef's seagrasses, the main food source for green turtles and dugongs, there has been a spike in the number of reported deaths of these species.

Using satellite telemetry, we plan to map the movements and habitat use of green turtles in the Hinchinbrook region of the northern Great Barrier Reef. This information will then be combined with data on the distribution and abundance of seagrass in the area to determine the turtles' foraging patterns in response to the changed feeding conditions.

From this, Marine Park managers will be able to identify areas that may need special protection measures and will be able to implement more effective management actions. The research project will help GBRMPA identify potential refugia for green turtles and dugong populations which may lead to the consideration of other measures to minimise other impacts on this species and the seagrass habitats that support them.

A recent survey of the Seagrass-Watch monitoring site at Goold Island showed the onset of recovery with low abundances of *Halophila ovalis* and *Cymodocea serrulata* as well as *Enhalus acoroides* and *Halodule uninervis* in nearby areas. However, seagrass still remains absent at adjacent coastal and subtidal areas.

Dead turtle found floating off Goold Island in Missionary Bay, North Queensland LM

“Some Traditional Owner groups have introduced temporary suspensions on traditional hunting of turtle and dugong in their sea country in a proactive effort to allow the populations to recover...”

A team of marine specialists from the GBRMPA, JCU, QPWS and Traditional Owner rangers from Giringun Aboriginal Corporation went on their first turtle rodeo off Cardwell, in north Queensland, on 6 October 2011.

They had hoped to catch up to three green turtles and fit them with satellite tags. However, due to high turbidity only one suitable turtle was captured. A large female (110 cm curved carapace length (CCL)) weighing in at around 160 kg was tagged on the front flipper and fitted with a satellite transmitter attached to her carapace. She was named "Arana", meaning moon, a name chosen by the Giringun junior rangers.

More than 35 green turtles were observed around the Missionary Bay - Goold Island area during the field trip. Juvenile, sub-adult and adult green turtles were found between Goold and Garden Islands. A search in the shallow sub-tidal waters in this area revealed no seagrasses.

Many juvenile green turtles were seen in the vicinity of rocky points in Missionary Bay, possibly indicating an increased abundance of algae or macro-zooplankton providing food for the turtles in that area. Most of the turtles seen here appeared to be healthy, however one sub-adult that was caught showed signs of extreme undernourishment (26 kg at 74 cm CCL).

Green turtles are the only marine turtle to feed primarily on plants mostly seagrasses and algae. However, they sometimes eat crustaceans. Due to this variability in



Alana tagged: A large female (110 cm curved carapace length) weighing in at around 160 kg was tagged on the front flipper and fitted with a satellite transmitter attached to her carapace. She was named "Alana" meaning moon, a name chosen by the Giringun junior rangers.

dietary requirements, the Great Barrier Reef's turtle populations are faring better overall than dugongs. The impact on green turtles has only been observed for coastal populations. Queensland's Department of Environment and Resource Management and JCU are monitoring off shore populations to determine the effect of the extreme weather on their health and habitat.

A second day of field work will be conducted in November, where the remaining turtles will be caught and tagged. Data from all these turtles will be

available at seaturtle.org from mid-November. The GBRMPA, QPWS, JCU and the Giringun Salt Water Rangers will continue to monitor seagrasses in the Hinchinbrook region when possible throughout this project.

In response to concerns about the high rate of deaths for these species, fishermen in 'hotspots' such as Gladstone have voluntarily altered their netting practices to minimise the risk of turtles and dugongs getting caught. Some Traditional Owner groups have introduced temporary suspensions on traditional hunting of



Concern: A sub-adult that was caught showed signs of extreme undernourishment (26 kg at 74 cm curved carapace length).

PK



Seagrass is the main food source for green turtles and dugongs and as a result of the degradation of the Great Barrier Reef's seagrasses, there has been a spike in the number of reported deaths of these species.

turtle and dugong in their sea country in a proactive effort to allow the populations to recover.

The Agency is also encouraging Reef users to use the GBRMPA Sightings Network to report animals in unusual locations in the Marine Park. The program provides vital information that can assist GBRMPA to better understand the impact of extreme weather events on marine animals and their habitats.

In the past 30 years, the implementation of a range of management arrangements has been instrumental in helping strengthen green turtle and dugong populations in the Marine Park. Without these arrangements, today's populations would not be as large and the current events would pose an even greater threat to their long term survival.

Initiatives have included the designation of Dugong Protection Areas in the late 1990s, the mandatory fitting of turtle excluder devices (TED's) in the east Coast otter trawl fishery in 2000, the protection of foraging and nesting habitats through the introduction of the Great Barrier Reef Marine Park Zoning Plan in 2004 and significant changes to netting arrangements in 2009, including compulsory on-water attendance at nets.

Other measures such as the Reef Water Quality Protection Plan and the Reef Guardian Farmers and Graziers program aim to improve the quality of water entering the Great Barrier Reef. These involve working with coastal communities and industries to minimise the impact run-off has on the Reef.

The Reef Rescue Land and Sea Country Indigenous Partnerships program and Traditional Use of Marine Resources Agreements are also important platforms for the GBRMPA to work with Traditional Owners who are actively involved in managing sea country resources.

The GBRMPA is requesting individuals who find sick or dead turtles or dugongs to not interfere with the animals but to call the stranding hotline on 1300 ANIMAL (1300 264 625).

Editors note: Arana stopped transmitting on 21 October 2011. On the 3rd November 2011, an additional 4 adult female green turtles were fitted with transmitters. You can follow their movements at www.seaturtle.org/tracking/?project_id=642





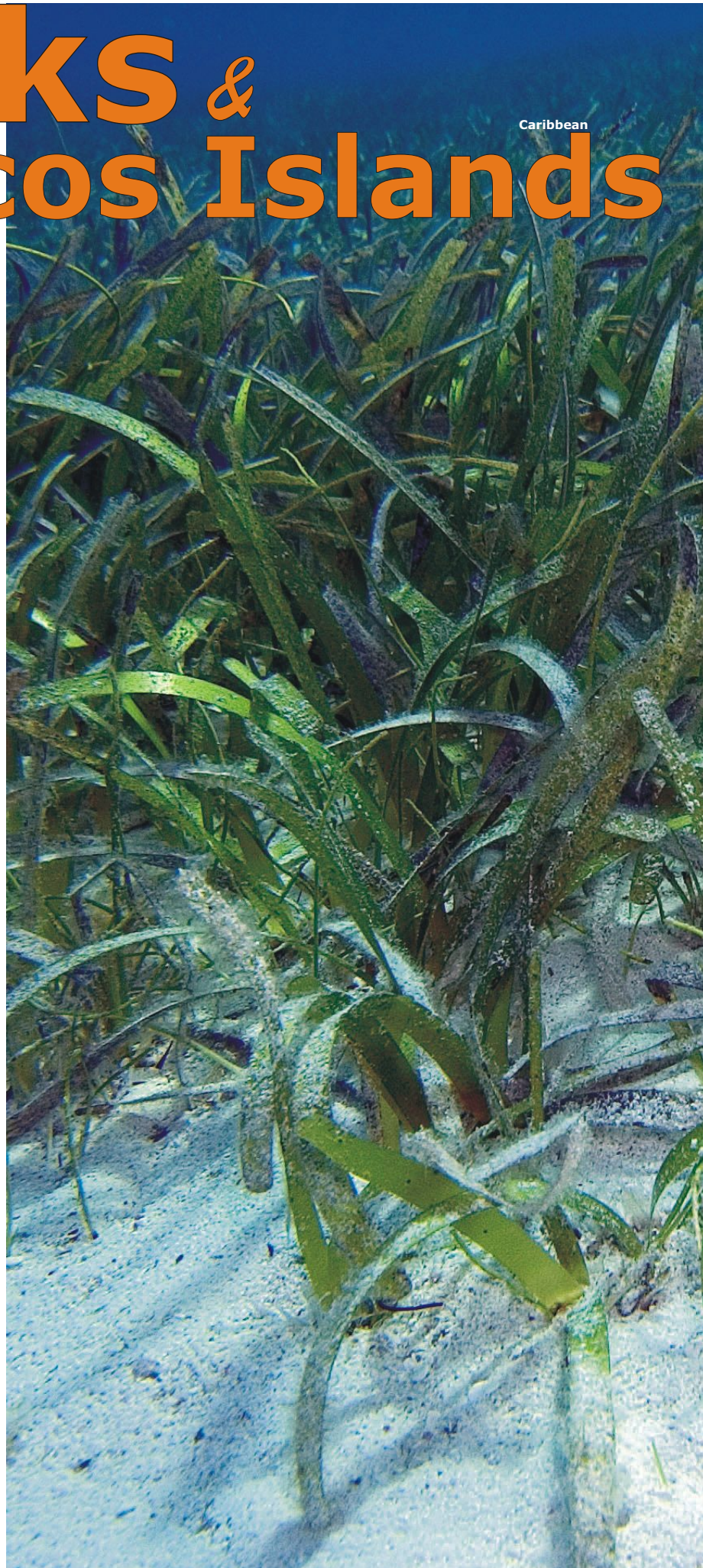
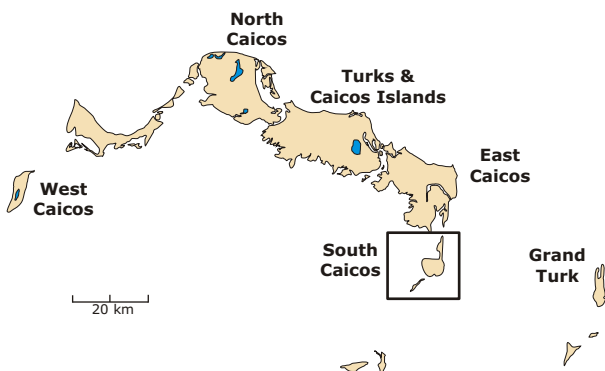
Turks & Caicos Islands

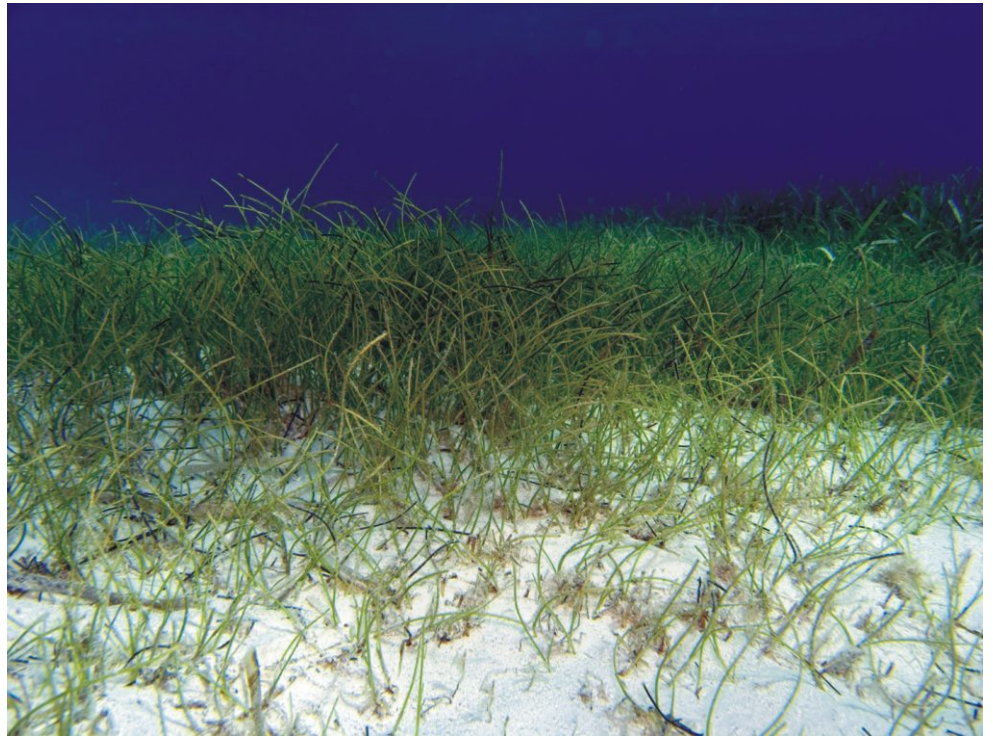
Caribbean

Article by Annemarie Kramer &
Alexandra Prebble
Photography Annemarie Kramer

THE Turks and Caicos Islands are located in the Tropical Western Atlantic and in large parts share Caribbean fauna and flora, biogeographically they are often related to the Bahamas. Seagrass meadows in the area have not been well documented; they are primarily located in channels protected by fringing reefs on the east and north coast and on the south westerly located Caicos Bank, an extensive shallow area. Species of seagrass commonly found in South Caicos are *Thalassia testudinum*, *Syringodium filiforme* and *Halodule wrightii*. From personal observations we know that there is at least one more species present which is rarely encountered, *Halophila engelmanni*.

Seagrass monitoring has become part of the Tropical Marine Ecology course which undergraduate students take during their study abroad semester at the School for Field Studies' Centre for Marine Resource Studies (CMRS) in South Caicos. The island has only a few hundred people as residents and the major income is fisheries for Queen Conch (*Strombus gigas*) and the Caribbean Spiny Lobster (*Panulirus argus*), reef fishes are only fished on a small scale. Two major resorts are being constructed on the island, hotels which could host more people than the island has residents. With this expected shift to mass tourism in the future, one of the goals of the CMRS is to evaluate current resources and assist in developing management strategies for natural resources. One of the methods applied is ecosystem monitoring. As part of the monitoring we started investigating three subtidal seagrass sites on the island:





Images: *Syringodium filiforme* (above)
Monitoring subtidal seagrass at South Caicos (below)

Site 1: a shallow, well protected bay area adjacent to a fringing reef where a large hotel is under construction and part of the seagrass in front of the beach has been dredged (East Bay),

Site 2: close to the fishing docks affected mainly by anchoring boats (Dock), and

Site 3: an area within the Admiral Cockburns Land and Sea Park which serves as a control site (SE Long Cay). Although transects are not permanently set, they are marked with GPS coordinates. Goals of our monitoring projects are to establish baseline data and detect any long-term changes.

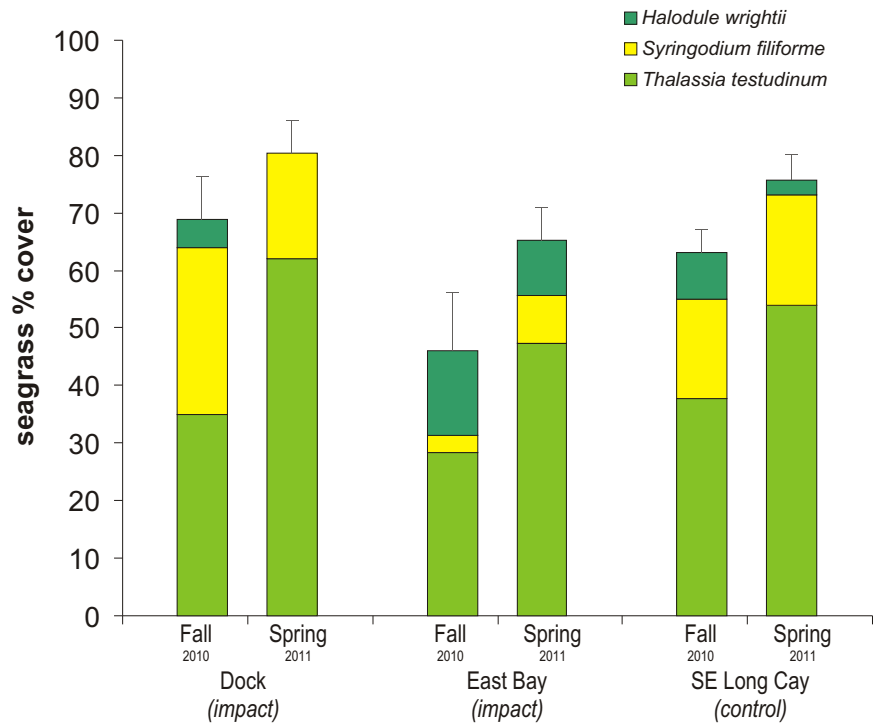
Monitoring followed the standard Seagrass-Watch protocols and has been conducted at all three sites on two occasions - once in fall 2010 and then again in spring 2011. Preliminary results found that average seagrass cover ranged from 50 to 81%, and was significantly different among sites. Seagrass cover and canopy height was consistently higher at the Dock site and did not differ between sampling events. Conversely, seagrass cover and canopy height at both the East Bay and SE Long Cay sites increased significantly in spring (2011). The higher seagrass abundance at the Dock sites may



be a consequence of elevated nutrients from fishing vessels and associated activities. The increase in seagrass cover in spring 2011 at the other sites was possibly seasonal, however further monitoring is required.

Abundance of macroalgae was also significantly higher at the Dock site, providing further evidence of possible elevated nutrients. Macroalgae abundance decreased at the control site (SE Long Cay) in 2011, however remained similar between sampling events at both impact sites.

With additional monitoring and data we hope to confirm if the trends we are seeing continue to differ between impacted and control sites. We are about to repeat the surveys at the same three sites; additionally we are going to measure biomass production of *T. testudinum*: seagrass blades will be marked and their growth measured within a week.



The Turks and Caicos Islands consist of 40 islands and cays, eight of which are inhabited. The islands are located 885 km (550 miles) southeast of Miami, Florida, just below the Bahamas chain and just to the east of Cuba and the island of Hispaniola (Dominican Republic and Haiti.) Technically, the Turks and Caicos are located in the Atlantic Ocean, not the Caribbean Sea. The islands are home to roughly 30,000 full time residents

The Turks & Caicos Islands are a British Crown Colony. A Governor is appointed by the Queen and presides over an Executive Council formed by an elected local self-government. Government offices are located in Grand Turk, with branches on other Islands as needed. The legal system is based on English Common Law.

Source: <http://www.turksandcaicostourism.com/>

Thalassia testudinum (below)



Australia turtle rehabilitation



Article by Jennifer Gilbert
Photography
Ergon Energy, Jennifer Gilbert
& Len McKenzie

THIS year, the Cairns Turtle Rehabilitation Centre (CTRC) has received unprecedented numbers of green sea turtles suffering from malnutrition and starvation. Many green sea turtles that have a staple diet of seagrass and algae appear now to be struggling to find sufficient food resources with the lack of inshore seagrass meadows. Data from the Marine wildlife stranding report indicates that the number of turtles found floating or washed up on the Queensland beaches has increased by 700% this year and the numbers floating or stranded are expected to continue until the seagrass meadows recover.

Turtles brought into the CTRC are in poor condition and show signs of malnutrition. These include a concave plastron, sunken eyes and no muscle mass around the flippers. All of these turtles are covered on the carapace to varying degrees by algae, an indicator that they have been floating for extended periods of time.

Many of these turtles are suffering from 'floaters syndrome' where an underlying problem causes a gas build up either in the intestine or the intestinal cavity which they are unable to remove. They can then die a slow and painful death because they are unable to dive down and feed. Floating on the surface also increases vulnerability to other impacts such as boat strike and predation from larger animals.

So far this year the CTRC has admitted 21 green turtles compared with 12 in 2008, 3 in 2009 and 13 in 2010, and the numbers will grow because the peak period for strandings during the year is between September and December. Out of the 21 turtles that have come into care 6 have died within a week. More turtles have been found dead before they reach the centre.

Necropsy results on green turtles that have died before or not long after coming into rehabilitation show conditions such as



EE



In poor condition (right): Turtles brought into Cairns Turtle Rehabilitation Centre were in poor condition. These include a concave plastron, sunken eyes and no muscle mass around the flippers

reduced or no muscle and body fat, an overload of parasites, impaction of the intestinal tract, disease and malnutrition. All of the other conditions could have been exaggerated by malnutrition. In some cases infection occurs which can result from health problems due to stress or underlying immune deficiencies. Stress resulting from changes in water temperature and reduction in water quality can create health issues which allow development of such infections.

The rehabilitation centre has also received three cases of fibropapilloma virus on green turtles this year, which is understood to be caused by a virus. The absence of fibropapilloma virus has been noted in turtles that inhabit foraging grounds around coral reefs of the Queensland coast in contrast to presence of fibropapilloma in turtles that inhabit inshore seagrass meadows⁽¹⁾. It has also been documented that fibropapilloma was more prominent in regions close to large human populations where water turnover rates were low⁽¹⁾. Theories suggest that pollution, reduced water quality and environmental stressors encourage this virus^(2,3).

Therefore the increase in the numbers of turtles that CTRC have seen this year could be a result of the reduced water quality after the floods early in 2011 and environmental stress associated with diminished inshore seagrass meadows.

The Cairns Turtle Rehabilitation Centre is now at capacity as is Reef HQ and JCU Townsville. CTRC is now setting up another rehabilitation centre at Fitzroy Island which will be able to take up to 20 tanks, taking the pressure from other centres. Turtles admitted to CTRC are currently flown free of charge from Mackay, Airlie Beach, Townsville and Pennefather beach (Cape York) by QantasLink. When the turtles arrive they are first taken to Marlin Coast Vet Clinic where they have a health assessment, including blood samples and x-rays. The treatments are donated by the vet clinic. If the turtles are emaciated they are put onto fluid therapy for 24 hours and then taken to CTRC to be rehabilitated. CTRC is funded totally by donations from the public and

companies. Without this, the rehabilitation centre would not be able to continue with this valuable work.

Both the rehabilitation and research regarding sea turtles admitted to the Cairns Turtle Rehabilitation Centre aims to improve conservation of sea turtles in the long term by returning rehabilitated animals to the wild population and establishing the underlying causes of the illnesses and injuries these turtles have suffered. Additionally released animals can be tracked to determine where their foraging grounds lie which should assist in monitoring of the state of seagrass meadows in the GBR region that have been affected by the extreme weather events of 2011.

- References:
- 1 Limpus and Miller (1994) In: James (ed) Proc. Australian Marine Turtle Conservation Workshop, QDEH/NC. pp.186-188.
 - 2 Balazs and Pooley (1991) Research plan for marine turtle fibropapilloma. U.S. Dep. Commer, NOAA Tech. Memo NMFS-SWFSC-156, 113 pp.
 - 3 George (1997) Chapter 14. In: The Biology of Sea Turtles (Lutz & Musick, eds)



Scrubbing: Volunteer scrubbing down a turtle, brought into the centre



Basking Turtle: Green turtles are the only sea turtle observed basking on intertidal banks where they are generally inactive. It is thought that they do this for thermoregulation (crucial for many bodily functions including digestion and reproduction), resting, or perhaps predator avoidance.

Fibropapilloma

what is it and it's effect on turtles

Contributions by
Ellen Ariel
Photography
Len McKenzie & Paul Wenzler



Tumours appear to manifest more often in stressful habitat conditions, such as regions with poor water quality, under eutrophication and in the presence of contaminants and toxins

Fibropapillomatosis is a debilitating disease, afflicting sea turtles worldwide. It is the only known global disease of an animal. In most cases, a herpes virus can be detected alongside the fibropapillomas. These results lead to the conclusion that a chelonian herpes virus is regularly associated with fibropapillomatosis and is not merely an incidental finding in affected turtles. Primarily reported on green sea turtles (*Chelonia mydas*) since the 1980's, it has now been found on all species of sea turtles.

The disease has been documented as far back as the 1930's from the US, but seems to have spread globally since then. The growths appear on sea turtles in warm water areas, especially around the equator, from Florida and South America to Hawaii and in Australia.

Fibropapilloma looks like large warts with a "cauliflower" texture that grow on all the

soft tissue areas of the sea turtle, including the eyes and mouth, and occasionally on the carapace and plastron. The colouration can be pink, white or black and can range in size from less than a centimetre to as large as a football.

In some cases the tumours establish internally on the lungs, kidneys, liver and intestines with a suspected fatal outcome⁽¹⁾. External fibropapillomas have been reported to regress in wild animals at an unknown rate. Depending on the number and size of external tumours, they can interfere with normal swimming and feeding and when the tumours affect the eyes and mouth, preventing the turtle from foraging effectively, they can lead to death from starvation. Internal tumours are thought to be particularly devastating in their obstruction of normal organ function. Blood analyses have indicated that turtles with many tumours are typically anaemic. However, there were

no differences in blood parameters between non-diseased and mildly afflicted green turtles with small amounts of tumours on their bodies.

Although treatments including surgical tumour removal and secondary care for debilitation of individual turtles have been moderately successful, the key to addressing this disease is to understand how it starts and spreads in the population.

Tumours appear to manifest more often in stressful habitat conditions, such as regions with poor water quality, under eutrophication and in the presence of contaminants and toxins^(2,3,4). However, a number of documented cases of fibropapillomatosis have been reported in areas considered relatively uncontaminated and studies on the role of environmental contaminants are imperative⁽⁵⁾.

The disease is spectacular even to the untrained eye, so it is therefore possible that the lack of reports of diseased animals until relatively recently, is reliable. On the east coast of Australia there seems to have been a northward spread from Moreton Bay in the early 80's with an increase in prevalence in previously unaffected areas. Recently, there has been an increased number of turtles with fibropapillomas stranded in far north Queensland, in areas that have not encountered this disease before.



References

1. Work (2005) *Hawaii Medical Journal* 64: 23-24.
2. Aguire et al. (2002) *Conservation Medicine: Ecological Health in Practice*. Oxford Univ. Press, NY pp. 79-94.
3. Ehrhert et al. (1996) A study of the population ecology of in-water marine turtle populations on the east-central Florida coast from 1982-96.
4. Adnyana et al. (1997) *Australian Veterinary Journal* 75: 737-742.
5. Herbst & Klein (1995) *Environmental Health Perspectives* 103: 27-30.

Sea turtles

Animal facts

Article & photography Len McKenzie

Sea turtles are cold-blooded, air breathing, egg laying reptiles that deposit their eggs on dry, sandy beaches. They inhabit almost every ocean and the seven species found today became distinct from all other turtles 110 million years ago. Sea turtles are divided into two families: Dermochelyidae (leatherback sea turtles) and Cheloniidae (Loggerhead, Hawksbill, Flatback, Olive Ridley, Kemp's Ridley and the Green Sea turtle). A sea turtle commonly seen in seagrass meadows, is the green turtle (*Chelonia mydas*), which feeds on seagrass and macroalgae.

The most distinctive feature of sea turtles is their shell. The top side of the shell is called the carapace and is actually the broadened, fused ribs of the turtle. Carapace shape depends on species, but ranges from oval to heart-shaped. Similarly, carapace colour depends on species, but can differ depending where the animal lives. The bottom side of the shell (under the body) is called the plastron. The shell is covered by a layer of horny plates called scutes. The flippers (front and hind legs) are highly evolved and adapted for swimming. On each fore flipper are either one or two claws. Breeding turtles also have a tail which is longer in males than females.

Time to reach sexual maturity varies greatly, depending on species, and where they live and their diet - green turtles take between 20 to 50 years. During spring, male and female turtles of most species migrate, often thousands of kilometres, from their feeding grounds to the courtship areas located close to the nesting beaches where the turtles first hatched. This usually happens several

weeks before the nesting season. Copulation takes place in the water and fertilization is internal. To help the males grasp on to shell of the females, they have enlarged claws on their front flippers.

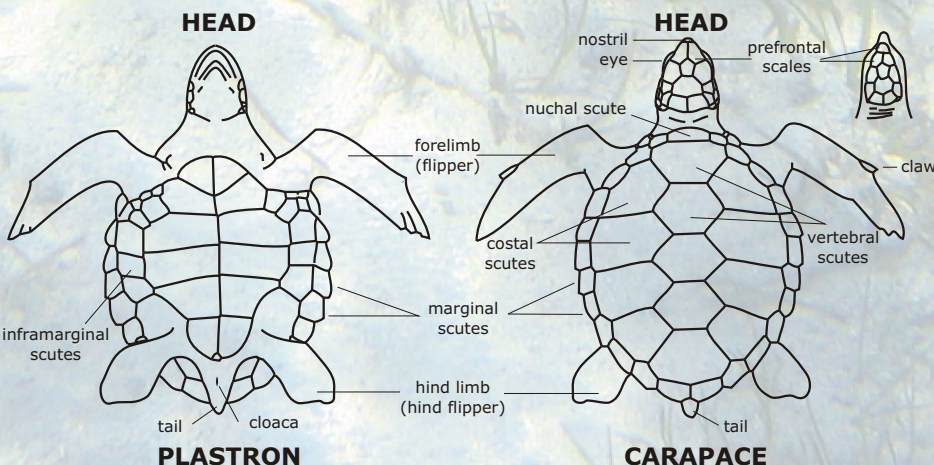
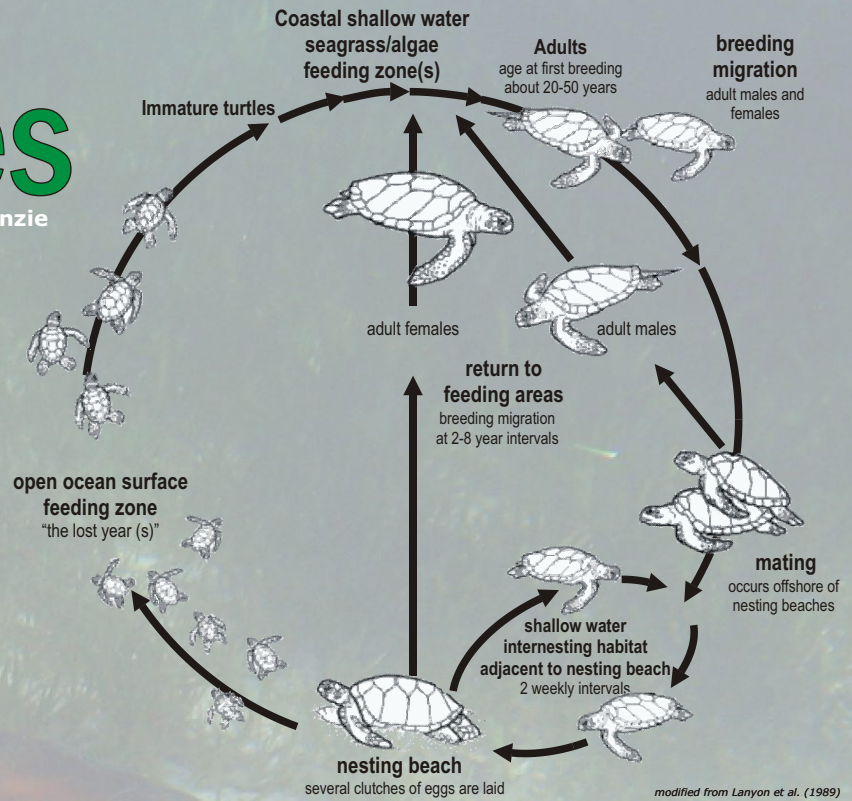
A few weeks after mating, the females come ashore at night during high tide on a sandy beach. Using her flippers to dig a nest, she will deposit between 50 and 200 eggs. Depending on species a female will lay between one and five clutches of eggs in a season. Most of these will be laid on the same beach, but some females actually visit more than one nesting beach in a season. After 50-70 days the eggs will hatch. Temperature during incubation determines the sex of the hatchling - if greater than the pivotal temperature then more hatchlings will be female and if lower more will be male. Eggs hatch at night, from early summer until late autumn, and the hatchlings head straight for the sea.

Sea turtle diet varies depending on species. Green turtles display an ontogenetic shift in diet and habitat use

during development. During their early life stage, juvenile green turtles in the southwestern Pacific inhabit the pelagic zone where they feed omnivorously on soft-bodied invertebrates such as jellies and jelly-like organisms. At approximately 44 cm CCL they recruit to inshore foraging habitats where they become primarily herbivorous.

The large bony shell of the sea turtle is one of the most important protections it has against predators. Tiger sharks and killer whales are known to eat adult turtles. Fishes, dogs, seabirds, wild pigs, ghost crabs, and other predators prey on eggs and hatchlings. More than 90% of hatchlings are eaten by predators. Like many other animals, sea turtle have been hunted by humans for centuries. Not just for their meat, but also for their decorative shells. However, many threats are incidental, including fisheries bycatch, coastal development at nesting beaches, habitat degradation at feeding areas, and disease.

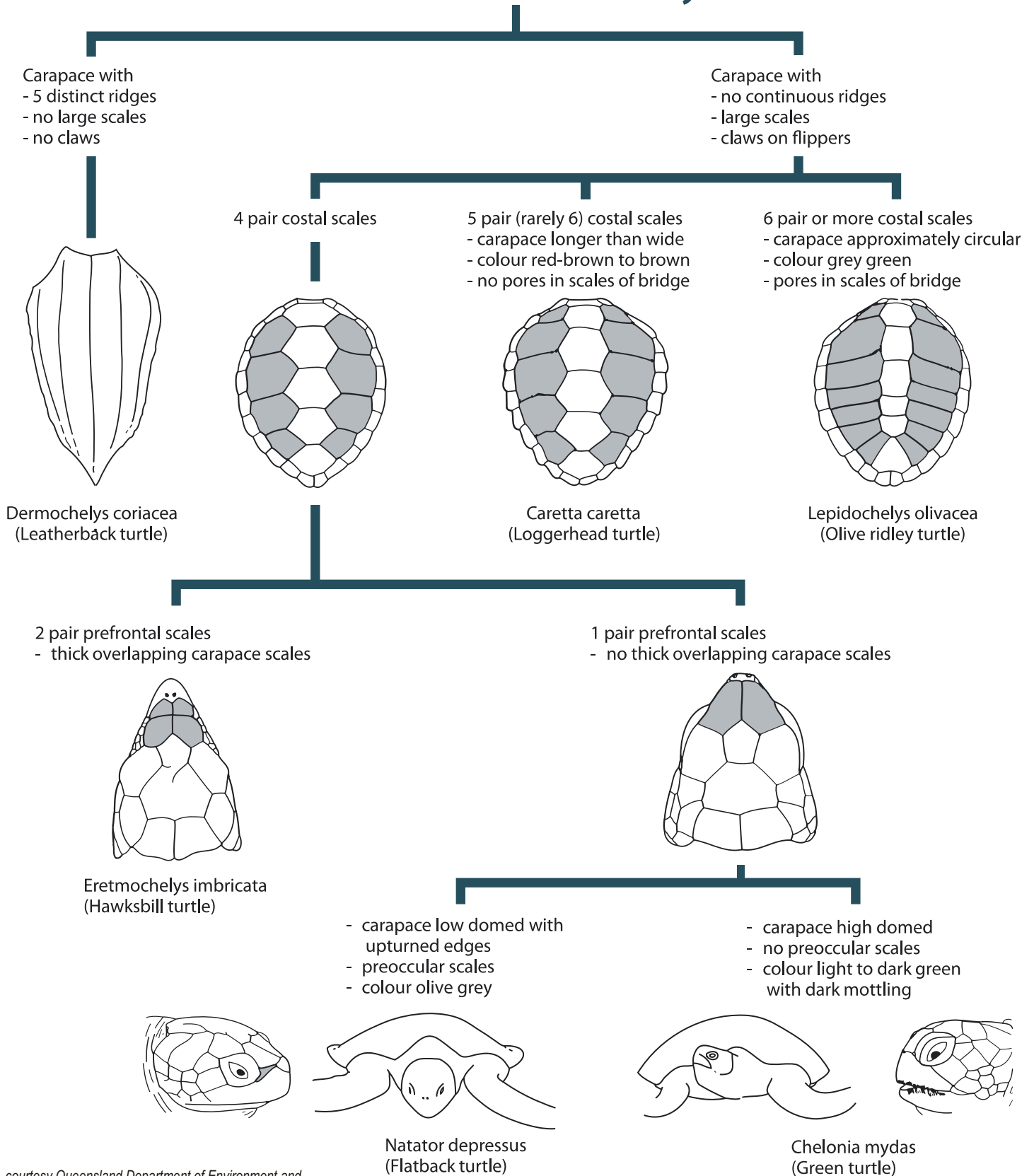
The green turtle has the most numerous and widely dispersed nesting sites of the seven species, and was once highly sought after for its body fat a key ingredient in the popular delicacy, 'green turtle soup.' Although it has become illegal to trade them in many parts of the world, green turtles and their eggs continue to be consumed. Unfortunately, due to human pressures, most sea turtles today are either Endangered or Critically Endangered.



<http://www.gbmpa.gov.au/about-the-reef/animals/marine-turtles>
<http://www.seaturtlestatus.org/learn/turtles/green>
<http://www.iucnredlist.org/apps/redlist/details/4615/0>

Indo-Pacific marine turtles

Identification key



courtesy Queensland Department of Environment and Resource Management
www.derm.qld.gov.au

major sponsors



Queensland Government



Australian Government
 Department of Sustainability, Environment,
 Water, Population and Communities
 Great Barrier Reef Marine Park Authority